



Caltrans Division of Research,
Innovation and System Information

Research Results

Right of Way/
Land Surveys

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Project Title:

Field Use of 3D Terrestrial Laser Scanning on Caltrans Projects

Task Number: 2056

Completion Date: June 30, 2012

This project applied 3D terrestrial laser scanning standards and workflows in transportation case studies and field use to accelerate project delivery, improve quality, and enhance safety for Caltrans operations.

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3D Terrestrial Laser Scanning

Using highly accurate and safer 3D ground-based laser scanners for surveying pavements, bridge structures, and roadways

WHAT WAS THE NEED?

Terrestrial laser scanners (TLS) are a new class of survey instruments that are increasingly used in providing modeling data for various applications, including land surveying, architecture, bridge structures, and highway construction. These ground-based 3D scanners use advanced laser measurement technology capable of obtaining thousands of point measurements per second. They generate a highly detailed data set, which can then be used to create an accurate and comprehensive 3D Computer-Aided Design (CAD) model.

The 3D laser scanners provide surveyors data that would otherwise be difficult or impossible to measure using traditional surveying instruments. In the traditional survey process, surveyors, particularly the rod person, are often exposed to a variety of environmental hazards, including walking across roadways with high-speed traffic, climbing steep slopes, and standing close to traffic.

Other transportation departments and private contractors have used laser scanning in highway survey applications and found that it reduces the need for lane closures, decreases the risk of injuries, and increases productivity. The resulting detailed 3D model allows engineers and surveyors to extract all the required data in the office, decreasing or eliminating the need for surveyors to return to the site for additional measurements.

WHAT WAS OUR GOAL?

The project's objective was to perform case studies of field applications using fixed 3D laser scanners to analyze their applicability, costs, and benefits for surveying pavements, bridge structures, roadside assets, and other Caltrans application areas, in addition to developing best practices and workflows and providing operator training.



Caltrans District 11 crew surveys the Highway 805 and 905 interchange using a ScanStation 2 laser scanner during training.



Caltrans improves mobility across California by performing applied research, developing innovations, and implementing solutions.

WHAT DID WE DO?

UC Davis's Advanced Highway Maintenance and Construction Technology (AHMCT) Research Center, in partnership with the Caltrans Office of Land Surveys, did the following:

- Field tested, operated, and collected data using 3D terrestrial laser scanners
- Developed best practices and workflows for implementing 3D terrestrial laser scanners
- Provided TLS training for Caltrans survey crews from several districts
- Produced in-depth material to support future Caltrans training, deployment, and on-going use of 3D laser scanning
- Documented how to plan and scan field work, set up scanner and troubleshoot, and process the collected data

WHAT WAS THE OUTCOME?

Caltrans has successfully deployed the new TLS technology for its surveyors. It has acquired its own TLS systems and is using them as part of its regular surveying operations. Compared to traditional survey instruments, which are limited to locating one point at a time and can only measure up to eight distances per second, the 3D laser scanners are capable of measuring, as of this research, up to 50,000 distances per second, with the speeds increasing for emerging commercial systems.

Well-trained survey personnel are capable of applying fixed 3D terrestrial laser scanning using Caltrans-specific workflows for efficient and consistent results. The collected high-accuracy, feature-rich data allow users to generate surveys on demand by extracting the desired features and attributes, without having to return to the field for measurements. Engineers can obtain model information, such as relative angle and length dimensions, from the resulting 3D surface CAD model.



Night scanning of the old Bay Bridge for the design and construction of the new Bay Bridge detour in District 4

WHAT IS THE BENEFIT?

The 3D ground-based laser scanners accelerate project delivery and improve the quality and efficiency of Caltrans operations. The collected data can be stored and reused on demand. The technology allows operators to set up the equipment in a more convenient location, reducing lane closures and enhancing the safety of survey teams.

LEARN MORE

To view the report:

<http://ahmct.ucdavis.edu/pdf/UCD-ARR-09-02-28-02.pdf>



ScanStation 2 laser scanner in action during field-work training in District 2